SOIL ANALYSIS REPORT FOR BLUEBERRIES 05/17/11

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S110506-210
BAG NUMBER: 100632

SOIL WEIGHT: 4.20 g/5cc
CROP: BLUEBERRIES

MARLBORO COLLEGE-C HIPSCHMAN
MC CAMPUS BOX 350-PO BOX B
MARLBORO, VT 05344

COMMENTS: CHIPSCHMAN@MARLBORO.EDU

SAMPLE ID: SOCCER SLOPE

RECOMMENDATIONS FOR BLUEBERRIES

SOIL PH ADJUSTMENT:

NEW PLANTINGS
Soil pH is too high.
Incorporate elemental sulfur at 24 lbs per 1000 sq ft into the top 10 inches of soil.
Adjust soil pH well in advance of planting.

ESTABLISHED PLANTINGS
Soil pH is too high. Topdress elemental sulfur at 10 lbs per 1000 sq ft.

FERTILIZER:

The organic matter level of this soil appears to be in the acceptable range for blueberries. Good drainage must be maintained.

* Potassium (K) level is extremely high in this soil. DO NOT add K at this time.

NEW PLANTINGS
DO NOT fertilize at planting. Apply 1/6 lb Nitrogen PER 1000 sq ft (supplied as 3/4 lb per 1000 sq ft ammonium sulfate) 3 to 4 weeks after setting plants. Place in cirlces extending 12 inches beyond plant crowns. [Equivalent to 2 1/2 oz. (3 tblsp.) per plant.] Also at this time supply + 3/4 lb phosphorus (P2O5) PER 1000 sq ft.
For soils very low in organic matter, repeat application of ammonium sulfate 4 weeks later.

MATURE PLANTINGS
Prior to blossoming apply 3/4 lb Nitrogen + 3/4 lb phosphorus (P2O5) PER 1000 sq ft. Apply an additional 3/4 lb Nitrogen PER 1000 sq ft 4 to 6 weeks later. Increase Nitrogen supplied to 1 lb PER 1000 sq ft per application for very sandy soils low in organic matter. Increase to 1 1/2 lbs PER 1000 sq ft per application for freshly mulched plantings.

YOUNG PLANTINGS
Supply the recommended P2O5 and K2O for Mature Plantings. Base Nitrogen rates on age of planting. Beginning at New Planting rate, increase by 1/4 lb PER 1000 sq ft per year over a span of 7 years. After that time follow recommendations for Mature Plantings.

SOIL pH 5.9 NITROGEN: NO3-N = 18 ppm
BUFFER pH 6.5

NUTRIENT LEVELS:	PPM	Low Medium High Very High
Phosphorus (P)	2	XXX
Potassium (K)	137	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Calcium (Ca)	708	XXXXXXXXXXXXXXXXXXXXX
Magnesium (Mg)	63	XXXXXXXXXXXXXX

CATION EXCH CAP
11.6 Meq/100g

PERCENT BASE SATURATION
K= 3.6 Mg= 5.3 Ca=36.4

MICRONUTRIENT LEVELS
ALL NORMAL

EXTRACTABLE ALUMINUM: 138 ppm (Soil range: 10-250 ppm)

The lead level in this soil is low.

SOIL ANALYSIS REPORT FOR RESEARCH 05/17/11

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S110506-210
BAG NUMBER: 100632

SOIL WEIGHT: 4.20 g/5cc

MARLBORO COLLEGE-C HIPSCHMAN
MC CAMPUS BOX 350-PO BOX B
MARLBORO, VT 05344

COMMENTS: CHIPSCHMAN@MARLBORO.EDU

ANALYSIS REPORT

SAMPLE ID: SOCCER SLOPE
SOIL TYPE:

SOIL PH 5.9
BUFFER PH 6.5

ALUMINUM (AL): 138 PPM (Soil Range: 10-300)

NUTRIENT LEVELS:	PPM	LOW / MEDIUM / HIGH / VERY HIGH
PHOSPHORUS (P)	2	XXX
POTASSIUM (K)	137	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CALCIUM (CA)	708	XXXXXXXXXXXXXXXXXXXXX
MAGNESIUM (MG)	63	XXXXXXXXXXXXXXX
NITRATE (NO3-N)	18	XXXXXXXXXXXXX

CATION EXCH CAP
11.6 MEQ/100G

PERCENT BASE SATURATION
K= 3.6 MG= 5.3 CA=36.4

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.1	0.1-2.0	Copper	(Cu)	0.1	0.3-8.0
Manganese	(Mn)	2.8	3 - 20	Iron	(Fe)	8.0	1.0- 40
Zinc	(Zn)	0.8	0.1- 70	Sulfur	(S)	17.5	1.0- 40

EXTRACTED LEAD (PB) 2 PPM.
ESTIMATED TOTAL LEAD IS 47 PPM.
EXTRACTED CADMIUM (CD) 0.1 PPM.
EXTRACTED NICKEL (NI) 0.1 PPM.
EXTRACTED CHROMIUM (CR) 0.0 PPM.

COMMENTS

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.

SOIL ANALYSIS REPORT FOR HOME GARDENS 05/17/11

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S110506-211
BAG NUMBER: 100632

SOIL WEIGHT: 4.18 g/5cc
CROP: VEGETABLE

MARLBORO COLLEGE-C HIPSCHMAN
MC CAMPUS BOX 350-PO BOX B
MARLBORO, VT 05344

COMMENTS: CHIPSCHMAN@MARLBORO.EDU

SAMPLE ID: UPPER PLOT 1

RECOMMENDATIONS FOR HOME GARDENS:

SOIL PH ADJUSTMENT:
Your soil pH is in the desired range. No limestone is needed this year.

FERTILIZER:
** Your soil contains sufficient levels of potassium. You may apply the standard recommendations below, or you may provide sufficient nitrogen and phosphorus by using alternate sources to provide about 1/4 lb nitrogen and about 1/2 lb phosphorus per 100 sq ft.

** VEGETABLES: Apply 3-4 lbs 5-10-5 per 100 sq ft in early spring. Because the phosphorus level is low, apply 1/2 lb 0-46-0 per 100 sq ft, or apply the recommended organic source of phosphorus.

** ANNUAL FLOWERS: Apply 1.5 lbs 5-10-5 per 100 sq ft in early spring. Alternatively you may use one-half the ORGANIC recommendation given above.

** ROSE BUSHES: Apply 4 tablespoons of 5-10-5 per bush in early June and early August. None after August 15.

Avoid overfertilizing which can cause plant toxicity and can contribute to insect and disease problems.

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.2	0.1-2.0	Copper	(Cu)	0.1	0.3-8.0
Manganese	(Mn)	1.8	3 - 20	Iron	(Fe)	3.3	1.0- 40
Zinc	(Zn)	0.9	0.1- 70	Sulfur	(S)	23.5	1.0- 40

SOIL pH 6.5
BUFFER pH 6.7

NITROGEN: NO3-N = 2 ppm

NUTRIENT LEVELS:		PPM	Low	Medium	High	Very High
Phosphorus	(P)	2	XXX			
Potassium	(K)	133	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Calcium	(Ca)	1292	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Magnesium	(Mg)	127	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX			

CATION EXCH CAP
13.0 Meq/100g

PERCENT BASE SATURATION
K= 3.2 Mg= 9.6 Ca=59.7

MICRONUTRIENT LEVELS
ALL NORMAL

EXTRACTABLE ALUMINUM: 76 ppm (Soil range: 10-250 ppm)

The lead level in this soil is low.

VISIT www.umass.edu/soiltest FOR FURTHER INFORMATION ON SOIL TESTING AT UMASS.

SOIL ANALYSIS REPORT FOR RESEARCH 05/17/11

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S110506-211
BAG NUMBER: 100632

SOIL WEIGHT: 4.18 g/5cc

MARLBORO COLLEGE-C HIPSCHMAN
MC CAMPUS BOX 350-PO BOX B
MARLBORO, VT 05344

COMMENTS: CHIPSCHMAN@MARLBORO.EDU

ANALYSIS REPORT

SAMPLE ID: UPPER PLOT 1
SOIL TYPE:

SOIL PH 6.5
BUFFER PH 6.7

ALUMINUM (AL): 76 PPM (Soil Range: 10-300)

NUTRIENT LEVELS:	PPM	LOW	MEDIUM	HIGH	VERY HIGH
PHOSPHORUS (P)	2	XXX			
POTASSIUM (K)	133	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
CALCIUM (CA)	1292	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
MAGNESIUM (MG)	127	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
NITRATE (NO3-N)	2	X			

CATION EXCH CAP
13.0 MEQ/100G

PERCENT BASE SATURATION
K= 3.2 MG= 9.6 CA=59.7

MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.2	0.1-2.0
Manganese	(Mn)	1.8	3 - 20
Zinc	(Zn)	0.9	0.1- 70
Copper	(Cu)	0.1	0.3-8.0
Iron	(Fe)	3.3	1.0- 40
Sulfur	(S)	23.5	1.0- 40

EXTRACTED LEAD (PB) 1 PPM.
ESTIMATED TOTAL LEAD IS 44 PPM.
EXTRACTED CADMIUM (CD) 0.0 PPM.
EXTRACTED NICKEL (NI) 0.1 PPM.
EXTRACTED CHROMIUM (CR) 0.0 PPM.

COMMENTS

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.

SOIL ANALYSIS REPORT FOR HOME GARDENS 05/17/11

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S110506-212
BAG NUMBER: 100632

SOIL WEIGHT: 4.56 g/5cc
CROP: VEGETABLE

MARLBORO COLLEGE-C HIPSCHMAN
MC CAMPUS BOX 350-PO BOX B
MARLBORO, VT 05344

COMMENTS: CHIPSCHMAN@MARLBORO.EDU

SAMPLE ID: MIDDLE PLOT 2

RECOMMENDATIONS FOR HOME GARDENS:

SOIL PH ADJUSTMENT:
INCORPORATE 12 lbs of ground dolomitic (magnesium rich) limestone per 100 sq ft as early as possible prior to planting. Avoid mixing in lime when the soil is very wet.

FERTILIZER:
** Your soil contains sufficient levels of potassium. You may apply the standard recommendations below, or you may provide sufficient nitrogen and phosphorus by using alternate sources to provide about 1/4 lb nitrogen and about 1/2 lb phosphorus per 100 sq ft.

** VEGETABLES: Apply 3-4 lbs 5-10-5 per 100 sq ft in early spring. Because the phosphorus level is low, apply 1/2 lb 0-46-0 per 100 sq ft, or apply the recommended organic source of phosphorus.

** ANNUAL FLOWERS: Apply 1.5 lbs 5-10-5 per 100 sq ft in early spring. Alternatively you may use one-half the ORGANIC recommendation given above.

** ROSE BUSHES: Apply 4 tablespoons of 5-10-5 per bush in early June and early August. None after August 15.

Avoid overfertilizing which can cause plant toxicity and can contribute to insect and disease problems.

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.2	0.1-2.0	Copper	(Cu)	0.1	0.3-8.0
Manganese	(Mn)	2.3	3 - 20	Iron	(Fe)	3.9	1.0- 40
Zinc	(Zn)	0.9	0.1- 70	Sulfur	(S)	24.9	1.0- 40

SOIL pH 6.4
BUFFER pH 6.6

NITROGEN: NO3-N = 18 ppm

NUTRIENT LEVELS:		PPM	Low	Medium	High	Very High
Phosphorus	(P)	3	XXXXX			
Potassium	(K)	290	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Calcium	(Ca)	1243	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Magnesium	(Mg)	119	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX			

CATION EXCH CAP
13.3 Meq/100g

PERCENT BASE SATURATION
K= 6.2 Mg= 8.1 Ca=51.4

MICRONUTRIENT LEVELS
ALL NORMAL

EXTRACTABLE ALUMINUM: 85 ppm (Soil range: 10-250 ppm)

The lead level in this soil is low.

VISIT www.umass.edu/soiltest FOR FURTHER INFORMATION ON SOIL TESTING AT UMASS.

SOIL ANALYSIS REPORT FOR RESEARCH 05/17/11

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S110506-212
BAG NUMBER: 100632

SOIL WEIGHT: 4.56 g/5cc

MARLBORO COLLEGE-C HIPSCHMAN
MC CAMPUS BOX 350-PO BOX B
MARLBORO, VT 05344

COMMENTS: CHIPSCHMAN@MARLBORO.EDU

ANALYSIS REPORT

SAMPLE ID: MIDDLE PLOT 2
SOIL TYPE:

SOIL PH 6.4
BUFFER PH 6.6

ALUMINUM (AL): 85 PPM (Soil Range: 10-300)

NUTRIENT LEVELS:	PPM	LOW / MEDIUM / HIGH / VERY HIGH
PHOSPHORUS (P)	3	XXXXX
POTASSIUM (K)	290	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CALCIUM (CA)	1243	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
MAGNESIUM (MG)	119	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
NITRATE (NO3-N)	18	XXXXXXXXXXXXX

CATION EXCH CAP
13.3 MEQ/100G

PERCENT BASE SATURATION
K= 6.2 MG= 8.1 CA=51.4

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.2	0.1-2.0	Copper	(Cu)	0.1	0.3-8.0
Manganese	(Mn)	2.3	3 - 20	Iron	(Fe)	3.9	1.0- 40
Zinc	(Zn)	0.9	0.1- 70	Sulfur	(S)	24.9	1.0- 40

EXTRACTED LEAD (PB) 1 PPM.
ESTIMATED TOTAL LEAD IS 41 PPM.
EXTRACTED CADMIUM (CD) 0.0 PPM.
EXTRACTED NICKEL (NI) 0.1 PPM.
EXTRACTED CHROMIUM (CR) 0.0 PPM.

COMMENTS

SOIL ANALYSIS REPORT FOR HOME GARDENS 05/17/11

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S110506-213
BAG NUMBER: 100632

SOIL WEIGHT: 4.10 g/5cc
CROP: VEGETABLE

MARLBORO COLLEGE-C HIPSCHMAN
MC CAMPUS BOX 350-PO BOX B
MARLBORO, VT 05344

COMMENTS: CHIPSCHMAN@MARLBORO.EDU

SAMPLE ID: LOWER PLOT 3

RECOMMENDATIONS FOR HOME GARDENS:

SOIL PH ADJUSTMENT:
INCORPORATE 20 lbs of ground dolomitic (magnesium-rich) limestone per 100 sq ft as early as possible prior to planting. Because your soil pH is low, an additional -1 lbs of lime will be required to achieve the proper pH for vegetables. Split this remaining amount into small applications over succesive tillings in spring and fall. Avoid mixing in lime when the soil is very wet. Retest soil pH periodically.

FERTILIZER:
** VEGETABLES: Apply 4-5 lbs 5-10-5 per 100 sq ft in early spring.
OR, ORGANIC FERTILIZER:
If you prefer INSTEAD to provide nutrients from organic sources, apply the following materials per 100 sq ft prior to planting:
NITROGEN: 1-2 bushels well-rotted manure PLUS 1 lb dried blood
PHOSPHORUS: 6 lbs steamed bone meal OR 16 lbs rock phosphate
POTASSIUM: 5 lbs wood ash

** ANNUAL FLOWERS: Apply 2.0 lbs 5-10-5 per 100 sq ft in early spring. Alternatively you may use one-half the ORGANIC recommendation given above.

** ROSE BUSHES: Apply 5 tablespoons of 5-10-5 per bush in early June and early August. None after August 15.

Avoid overfertilizing which can cause plant toxicity and can contribute to insect and disease problems.

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.1	0.1-2.0	Copper	(Cu)	0.1	0.3-8.0
Manganese	(Mn)	2.4	3 - 20	Iron	(Fe)	5.7	1.0- 40
Zinc	(Zn)	0.8	0.1- 70	Sulfur	(S)	19.8	1.0- 40

SOIL pH 6.0
BUFFER pH 6.4

NITROGEN: NO3-N = 15 ppm

NUTRIENT LEVELS:		PPM	Low	Medium	High	Very High
Phosphorus	(P)	2	XXX			
Potassium	(K)	85	XXXXXXXXXXXXXXXXXXXX			
Calcium	(Ca)	740	XXXXXXXXXXXXXXXXXXXXXXX			
Magnesium	(Mg)	42	XXXXXXXXXX			

CATION EXCH CAP	PERCENT BASE SATURATION	MICRONUTRIENT LEVELS
13.2 Meq/100g	K= 2.1 Mg= 3.2 Ca=34.4	ALL NORMAL

EXTRACTABLE ALUMINUM: 209 ppm (Soil range: 10-250 ppm)

The lead level in this soil is low.

VISIT www.umass.edu/soiltest FOR FURTHER INFORMATION ON SOIL TESTING AT UMASS.

SOIL ANALYSIS REPORT FOR RESEARCH 05/17/11

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S110506-213
BAG NUMBER: 100632

SOIL WEIGHT: 4.10 g/5cc

MARLBORO COLLEGE-C HIPSCHMAN
MC CAMPUS BOX 350-PO BOX B
MARLBORO, VT 05344

COMMENTS: CHIPSCHMAN@MARLBORO.EDU

ANALYSIS REPORT

SAMPLE ID: LOWER PLOT 3
SOIL TYPE:

SOIL PH 6.0
BUFFER PH 6.4

ALUMINUM (AL): 209 PPM (Soil Range: 10-300)

NUTRIENT LEVELS:	PPM	LOW / MEDIUM / HIGH / VERY HIGH
PHOSPHORUS (P)	2	XXX
POTASSIUM (K)	85	XXXXXXXXXXXXXXXXXXX
CALCIUM (CA)	740	XXXXXXXXXXXXXXXXXXXXXX
MAGNESIUM (MG)	42	XXXXXXXXXX
NITRATE (NO3-N)	15	XXXXXXXXXX

CATION EXCH CAP
13.2 MEQ/100G

PERCENT BASE SATURATION
K= 2.1 MG= 3.2 CA=34.4

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.1	0.1-2.0	Copper	(Cu)	0.1	0.3-8.0
Manganese	(Mn)	2.4	3 - 20	Iron	(Fe)	5.7	1.0- 40
Zinc	(Zn)	0.8	0.1- 70	Sulfur	(S)	19.8	1.0- 40

EXTRACTED LEAD (PB) 2 PPM.
EXTRACTED CADMIUM (CD) 0.1 PPM.
EXTRACTED NICKEL (NI) 0.1 PPM.

ESTIMATED TOTAL LEAD IS 46 PPM.

EXTRACTED CHROMIUM (CR) 0.1 PPM.

COMMENTS

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.

UMass
Extension
CENTER FOR AGRICULTURE

Agriculture and Landscape Program
Soil and Plant Nutrient Testing Laboratory
West Experiment Station
682 North Pleasant Street
University of Massachusetts
Amherst, MA 01003-9302
Phone: 413.545.2311
Fax: 413.545.1931
www.umass.edu/soiltest/

To Whom It May Concern:

The UMass Soil Testing Laboratory has received payment

(Check #_____ (Cash) from Clare Hipschman

in the amount of $40 to cover the testing of

Soil. If there are any questions feel free

to contact the laboratory at the telephone number listed above.

Thank you, 5/18/2011

Kirsten Yarrows
Laboratory Assistant

UMASS EXTENSION

Results and Interpretation of Soil Test Results

Soil and Plant Tissue Testing Laboratory

The primary goal of soil testing is to provide guidelines for the efficient use of soil amendments, such as lime and fertilizer. Recommendations provided with your soil test are for the crop you have chosen. Problems directly related to disease, insects, and to some extent weather and cultural practices, cannot be addressed by a soil test.

The Soil Sample – One of the most important steps in soil testing is obtaining the soil sample. It should represent the soil in which the plants are or will be growing. Instructions for proper sampling may be obtained by visiting our website. Remember, a poor sample will result in inaccurate recommendations.

Soil pH, Buffer pH, and pH adjustments – **Soil pH** is a measure of the soil's acidity and is a primary factor in plant growth. When pH is maintained at the proper level for a given crop, plant nutrients are at maximum availability, toxic elements are often at reduced availability and beneficial soil organisms are most active. Most plants prefer a soil pH between 5.5 and 7.5. The majority do best in the middle part of this range. Some notable acid-loving exceptions are blueberries, potatoes and rhododendrons.

Due to climate and rock types in New England, soils here tend to be naturally very acidic (4.5-5.5). For this reason, amendments with materials capable of raising pH may be needed. Many products are available to accomplish this, but ground limestone is the most common.

Buffer pH is a measure of the soil's capacity to resist pH change. Two soils with the same soil pH may have quite a different buffer pH and thus one will require significantly more limestone than the other to obtain an optimal soil pH. The extent to which the buffer pH is lower than 6.8 is proportional to the amount of limestone needed. Occasionally soil pH must be lowered, because either the plant requires acid soil or the soil was previously over-limed. Incorporating elemental sulfur is the most effective way to lower soil pH. The sulfur oxidizes in the soil to sulfuric acid. One to two pounds of sulfur will lower the pH of most New England soils about 0.5 units. Unfortunately, sulfur is rarely available in garden centers.

Cation Exchange Capacity and Percentage Base Saturation- Cation exchange capacity (CEC) is an important measure of the soil's ability to retain and supply nutrients. The bulk of this capacity in limed New England soils resides in finely divided soil organic matter. A smaller contribution comes from the soil's clay particles. The basic nutrient cations (positively charged ions) of Calcium (Ca++), Magnesium (Mg++), and Potassium (K+), and the acidic cations of Aluminum (Al+++) and Hydrogen (H+) account for nearly all the absorbed cations in the soil. Very sandy soils low in organic matter commonly have CEC less than 5. New England soils with very high CEC (greater than 40) are invariably rich in organic matter. A CEC between 10 and 15 is typical and usually adequate.

CEC is important because it represents the primary soil reservoir of readily available K, Ca, Mg and several micronutrients. It also helps to prevent leaching of soil nutrients. The ease with which a plant gains access to these nutrients depends somewhat on the relative percentages of the absorbed cations. For this reason it is suggested that percentage saturation levels be held within loosely defined ranges. For example, a soil with a pH of about 6.5 and base saturations of Ca 70%, Mg 12% and K 4% is considered balanced for most crops.

Nitrogen (N) - Nitrogen is essential to nearly every aspect of plant growth. N is absorbed from the soil as nitrate (NO_3^-) and ammonium (NH_4^+). This soil test estimates current nitrate levels. Fertilizer recommendations are not generally made on the basis of these measurements because their levels can fluctuate greatly with soil and weather conditions over short periods of time. Instead, they are used to assess extremes of nitrogen fertility. For example, very high ammonium levels can be toxic to the roots of many plants, particularly if the soil pH is above 7. Very high levels of either form may result in fertilizer "burn." Recommendations are made on the presumption that very little N remains in the soil after the growing season and that most crops require between 1 and 4 lbs of N per 1000 square feet per year. Adjustments are often made for soils recently or continuously supplied with manure or compost. These materials contain N to be released during the growing season.

Phosphorus (P) or Phosphorus Pentoxide (P_2O_5) - Among other important functions, phosphorus provides plants with a means of using the energy harnessed by photosynthesis to drive its metabolism. A deficiency of this nutrient can lead to impaired vegetative

growth, weak root systems, and fruit and seed of poor quality and low yield. Soil P exists in a wide range of forms. Some is present as part of soil organic matter and becomes available to plants as the organic matter decomposes. Most inorganic soil P is bound tightly to the surface of soil mineral particles. Warm, moist, well-aerated soils at about pH 6.5 optimize the release of both these forms. Plants require fairly large quantities of P, but the plant-available levels are quite low at any one time. Soil tests attempt to assess the soil's ability to supply P from bound forms during the growing season.

Potassium (K) or Potash (K2O) – Potassium rivals nitrogen as the nutrient element absorbed in greatest amounts by plants. Like N, crops take up a relatively large proportion of plant-available K each growing season. Plants deficient in K are unable to utilize N and water efficiently, and are more susceptible to disease. Most available K exists as an exchangeable cation (see above). The slow release of K from native soil minerals can replenish some of the K lost by crop removal and leaching. This ability, however, is limited and variable. Fertilization is often necessary to maintain optimum yields.

Calcium (Ca) – Calcium is essential in the proper functioning of plant cell walls and membranes. Sufficient Ca must also be present in actively growing plant parts, especially storage organs such as fruits and roots. Properly limed soils with constant and adequate moisture will normally supply sufficient Ca to plants. High humidity and poor soil drainage hinder Ca movement into these plant parts and should be avoided.

Magnesium (Mg) – Magnesium acts together with P to drive plant metabolism and chlorophyll production, a vital substance for photosynthesis. Like Ca, Mg is ordinarily supplied through liming. Low Mg levels in many soils will not normally cause problems provided the exchangeable cations (see above) are in good balance. If Mg levels are low and lime is required, dolomitic lime (rich in Mg) will be recommended. If Mg is low and lime is not required, Epsom salt (magnesium sulfate) may be incorporated at a rate of 5 – 10 lbs/1000 square feet.

Micronutrients - Micronutrients are essential plants elements that are required in very small amounts. In most properly limed soils they are available in sufficient quantities. Five of these (iron, manganese, zinc, copper, and boron) are tested routinely. Micronutrient fertilizer recommendations are not available. Extremely high values, however, are noted.

Aluminum (Al) - Aluminum is not an essential nutrient for plants. At elevated levels it can be extremely toxic to plant roots and limit the plant's ability to take up P. Extractable Al increases greatly at soil pH below 5.5. Proper liming, however, will lower Al to acceptable levels. Al sensitivity varies greatly with plant type. Acid-loving plants, such as rhododendrons, can tolerate very high Al levels. Lettuce, carrots and beets are very sensitive. Hydrangea, a non-sensitive plant, produces blue flowers at low pH and pink flowers at high pH due to the effect of Al on pigment formation.

Toxic Heavy Metals- This laboratory routinely tests lead (Pb) and cadmium (Cd). Pb is naturally present in soils in the range of 15-40 parts per million (ppm). These levels present no danger to people or plants. Soil pollution with lead-based paints and the leaded fuels of the past have increased soil Pb levels to several thousand ppm in some places. Unless the total Pb level in your soil exceeds 150 ppm, it is simply reported as low and can be considered safe (assuming the sample submitted was representative of the area of concern). Values above 300 ppm are potentially dangerous to people. In such cases consult the separate insert on soil lead levels.

Cadmium is extremely toxic to both plants and animals. It is naturally present in soils at low levels (less than 1 ppm). Industrial discharges of Cd, however, often cause municipal sewage sludge to contain elevated levels of Cd. Composted sludges are often used as soil amendments. Although safe upper limits of Cd for both plants and animals have not been established, monitoring soil Cd levels helps avoid excesses when such materials are used. Unless the Cd in your soil exceeds 1 ppm it is not reported.

Soluble Salts (SS) - Soluble salts (SS) include materials used on roads to melt ice and are present in many fertilizers. SS can cause severe water stress and nutritional imbalances in plants. Generally, seedlings are more sensitive than established plants to elevated SS levels. Also, a great variation exists between plant species. SS levels are determined through a measure of electrical conductivity. Most soils have values between 0.08 and 0.50 dS/m (deciSiemens/meter) by the method used in this lab. The middle of this range is typical of most fertile mineral soils. Values higher than 0.60 dS/m may cause damage to sensitive plants (such as onions, etc.). A SS level can change rapidly in the soil due to leaching so the effects of time and growing conditions must be considered. Excessive SS levels can often be corrected by applying liberal amounts (2- 4 inches) of fresh water. Normal off-season precipitation will usually correct salt problems resulting from over-fertilization.

****

For more information regarding soil testing, visit our website at **www.umass.edu/soiltest**

Using Lime and Fertilizer in the Home Landscape

The recommendations provided on your soil test have hopefully been written in a way that is both understandable and convenient for you to use. It is difficult to express these in a way that matches every individual's preference. Some wish to use only natural soil amendments. Others request recommendations in terms of soluble synthetic fertilizers. Most soil tests state the number of pounds of nutrient to apply per given area (to be incorporated through a specified depth). In home gardens the small amounts recommended may be difficult to weigh accurately. It is often much easier to apply a volume of fertilizer (cup, liter, etc.). Your soil test will state the amounts of Nitrogen, Phosphorus, and Potassium recommended for your crop in terms of lbs per specified soil area (or volume). It will then provide you with one way of supplying these nutrients. Use the following tables as an aid in implementing this recommendation or to devise alternatives based on your basic N, P, K soil test recommendation.

Fertilizer Products and Their Properties

Table 1 converts weights to volumes for several fertilizer groups. For example, if your soil test recommendation calls for 3 lbs Bone Meal, under Organic Meals and Blends you find that a one cup measure holds 1/3 lb of Bone Meal. That means 3 cups would hold 1 lb, and 9 cups would hold 3 lbs. One could measure out 9 cups or use a cut-off 2 liter soda container, which also holds 3 lbs of Bone Meal. When measuring volumes scoop the material and level the container top (do not pack).

Table 1. Density Equivalents

	Density Units			
Fertilizer Groups	grams/cc	lbs/cup	lbs/2 liters	lbs/gal (oz/cup)
Organic Meals, Blends, and Wood Ash	0.7	1/3	3	6
Ground Rock Dusts (ex. Lime, Rock Phosphate, Greensand)	1.4	3/4	6	12
Coarse and Medium Granulated Synthetic Blends (ex. 5-10-10 graden fertilizer)	1.0	1/2	4.5	8.5
Fine Granulated and Flaked Synthetic Blends (ex. many turf fertilizers)	0.7	1/3	3	6
Composts	0.35	1/6	1.5	3
Powdered Sulfur	1.0	1/2	4.5	8.5
Urea and Other High Nitrogen Fertilizers	0.80	1/3	3.5	7

Some Convenient Containers for Measuring Fertilizers

12 oz Coffee Can = 1 liter
Dry Wall Compound Bucket = 5 gallons
Kitchen Measuring Cup = Graduated
Cut-off 2 liter Soda Bottle = 2 liters
Cut-off 1/2 gallon Milk Container = 1/2 gallon

SUPPLYING INDIVIDUAL NUTRIENTS

If your soil test calls for a quantity of nitrogen, phosphorus, or potassium expressed in fractions of a pound per 100 square feet, you may use one of the combinations listed below to meet that recommendation.

1/4 lb nitrogen (N):

1 bushel (1.25 cubic feet) well-rotted or composted manure plus 1 lb dried blood (12-0-0)
OR
3 to 4 lbs dried blood (12-0-0)
OR
1/2 lb urea (42-0-0)

1/4 lb phosphorus (P2O5)

3 to 4 lbs bone meal (0-12-0)
OR
1/2 lb triple superphosphate (0-45-0)

1/4 lb potassium (K2O)

4 to 5 lbs wood ash (0-0-5) (use only if soil pH is les than 6.3 and reduce lime recommendation by 3 to 4 lbs)
OR
1/2 lb muriate of potash (0-0-60) or potassium sulfate (0-0-50) (potassium sulfate is preferred but is more difficult to find)

If recommendation calls for 1/2 lb of nutrient, simply double the quantity recommended for 1/4 lb.

For annual flowers use 1/2 the amount recommended for vegetables.